ALEX PADILLA | SECRETARY OF STATE | STATE OF CALIFORNIA
OFFICE OF VOTING SYSTEMS TECHNOLOGY ASSESSMENT
1500 11th Street | Sacramento, CA 95814 | **Tel** 916.653.7244 | **Fax** 916.653.4620 | www.sos.ca.gov

Election Systems & Software
Unity 3.4.1.0

AutoMARK Voter Assist Terminal, version 1.3.2907
AutoMARK Information Management System, v 1.3.257
Model DS200 Precinct Scanner, v 1.7.0.0
Model M100 Precinct Scanner, v 5.4.4.5
Model DS850 Central Scanner, v 2.9.0.0
Model M650 Central Scanner, v 2.2.2.0
UNITY Election Management System, v 3.4.1.0

Staff Report

Prepared by:
Secretary of State's Office of
Voting Systems Technology Assessment
November 15, 2016

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I. INTRODUCTION

1. Scope

This report presents the test results for the five phases of the certification test of the Election Systems and Software Unity 3.4.1.0 voting system. The purpose of the testing is to test the compliance of the voting system with California and Federal laws. Testing also uncovers other findings, which do not constitute non-compliance, and those findings are reported to the voting system vendor to address the issues procedurally. The procedures for mitigating any additional findings are made to the documentation, specifically the ES&S Use Procedures.

2. Summary of the Application

Elections Systems and Software Inc. submitted an application for the Unity 3.4.1.0 voting system, comprised of the following major components:

- AutoMARK Voter Assist Terminal (VAT) version 1.3.2907;
- Model M100 Precinct Scanner, version 5.4.4.5;
- Model DS200 Precinct Scanner, version 1.7.0.0;
- Model DS850 Central Scanner, version 2.9.0.0;
- Model M650 Central Scanner, version 2.2.2.0; and
- AIMS Election Management System, version 1.3.257.

In addition to these major components, which includes the executable code and the source code, ES&S was required to submit the following: 1) the technical documentation package (TDP); 2) all the hardware components to field two complete working versions of the system, including all peripheral devices, one for the Functional Test Phase and one for the Red Team Penetration Test Phase; 3) twenty (20) AutoMARK voting machines, and all the peripherals that would be in the polling place; and 4) the ES&S Use Procedures.

3. Contracting and Outsourcing

Upon receipt of a complete application, the Secretary of State released a Request for Proposal (RFP) for assistance with the Security Review, both Source Code and Red Team Penetration testing. The statement of work (SOW) also had an option for the Secretary of State to use the awarded contractor for Functional testing, if it deemed necessary.

Through the formal California contracting process, the Secretary of State awarded a contract to Freeman, Craft, McGregor Group, Inc. (FCMG), who would sub-contract portions of the review to Atsec Information Security, Corp. (@sec).

II. SUMMARY OF THE SYSTEM

The system consists of seven components:

1. AutoMARK Voter Assist Terminal (VAT), v. 1.3.2907

The AutoMARK Voter Assist Terminal enables voters who are visually or physically impaired or voters who are more comfortable reading or hearing instructions and choices in an alternative language to privately mark paper ballots.

The AutoMARK supports navigation through touchscreen, physical keypad or Americans with Physical Disabilities Act support peripherals such as a sip and puff device or two position switch. The touch screen visually guides the voter through the ballot marking process with screen text and symbols. Touch screen controls meet all applicable guidelines for size and readability. The physical keypad was designed with extensive input from special needs groups. Each key is shaped and positioned to provide an intuitive voting session and labeled in both Braille and printed text to indicate function.

A voter using this device simply inserts his or her blank ballot. The AutoMARK then scans the ballot to determine the correct ballot style configuration and displays the ballot through a series of screens on a touch-screen monitor (similar to DRE voting devices). The AutoMARK is capable of being programmed to provide instruction and display the ballot in multiple languages. The AutoMARK supports visually impaired voters through audio instruction and a Braille coded keypad. In this mode, the screen can be blanked to insure voter privacy. This audio mode also supports multiple languages. Finally, physically impaired voters can vote on the AutoMARK using a foot-pedal or by connecting an included disposable sip-puff device.

If a marked ballot is inserted into the AutoMARK, it will display the marked vote choices on the screen for verification and will also provide that verification through the audio mode.

The AutoMARK does not store, count or tabulate voted ballots. It can only be used to mark optical scan ballots for tabulation by another device or to confirm the vote choices on a voted ballot.

2. AutoMARK Information Management System (AIMS), v. 1.3.257

The AutoMARK Management Information System (AIMS) is composed of a compatible PC computer and the AIMS application software that manages all of the information required by the AutoMARK for an election. AIMS imports data configured in ESSIM to configure the audio and visual

ballot presentation for the AutoMARK and to accurately mark inserted ballots.

3. Model M100 Precinct Scanner, v. 5.4.4.5

The Model M100 is a precinct-based, voter-activated paper ballot tabulator. The system uses advanced Intelligent Mark Recognition (IMR) visible light scanning technology to accurately detect completed ballot targets. This visible light technology allows the ballot to be read in any orientation as it is fed into the machine. It is usually used to tabulate ballots in a polling place, but may also be used as a central count device in small jurisdictions.

4. Model DS200 Precinct Scanner, v. 1.7.0.0

The Model DS200 is a digital scan tabulator that scans and stores a full-page image of the ballot. During tabulation, the images are processed by proprietary mark recognition software. It is generally used to tabulate ballots in a polling place, but may be used as a central count device in small jurisdictions.

5. Model DS850 Central Ballot Scanner, v. 2.9.0.0

The DS850 is a high-speed digital scan ballot counter that scans and stores ballot images and is used in central count operations. During tabulation, the images are processed by proprietary mark recognition software. This tabulator can out stack write-in ballots and unreadable ballots into separate batches. Ballots may be fed in any orientation.

6. Model M650 Central Ballot Scanner, v. 2.2.2.0

The M650 is a high speed, optical scan ballot counter used in central count operations. It is generally used to tabulate mail-in and provisional ballots. It can only read the ballot from one orientation and requires that the ballot be fed in only that direction.

7. UNITY Election Management System, v. 3.4.1.0

Unity is an election management system software package composed of the following subcomponents:

- Audit Manager (AM) 7.5.2.0
- Election Data Manager (EDM) 7.8.2.0
- ES&S Image Manager (ESSIM) 7.7.2.0
- Hardware Programming Manager (HPM) 5.9.0.0
- Election Report Manager (ERM) 7.9.0.0
- VAT Previewer 1.3.2907
- LogMonitor Service 1.1.0.0

Before an election, Unity is used by a jurisdiction to create the ballot definition for an election. Unity is then used to program the various media used by the different vote counting components. After the election, Unity is used to compile and tabulate election returns from throughout the jurisdiction. Finally Unity contains a series of additional reporting functions.

III. TESTING INFORMATION AND RESULTS

1. Background

ES&S submitted an application to the Secretary of State for certification of the Unity 3.4.1.0 voting system on February 6, 2015. The Elections Assistance Commission (EAC) certified this version of the system on April 4, 2014, with the EAC Certification Number: ESSUnity3410.

State examination and functional, source code review, and Red Team testing of this system was conducted by Secretary of State staff in conjunction with the State's technical consultant, Freeman, Craft, McGregor Group (FCMG) at the Secretary of State's office in Sacramento, California from February 2 through February 5, 2016. Additional functional testing was performed from May 2 through May 6, 2016. Red Team testing was performed at the Secretary of State's office in Sacramento, California from May 9 through May 13, 2016. Volume testing was conducted by Secretary of State staff, along with 20 temporary workers at the Sacramento County Elections office warehouse from August 15 through August 17, 2016.

Prior to functional testing, the operating system was installed and benchmarks were established. The State of California's test procedures require that the hard drives of computers used in testing be completely wiped and a fresh installation of the operating system be completed. Following the vendor's documentation, the system software and all required supporting utilities were installed from trusted installation media.

Functional testing is typically divided into two phases. Phase I includes the steps necessary to install the system, develop test elections, provide ES&S with the data required to print test ballots and to prepare equipment for Red Team Penetration Testing. Phase II exercises the system by following ES&S's Use Procedures to stage an election, document the test results, and prepare benchmark data for future forensic validation of the system by the California Secretary of State.

Test elections used for functional testing included a Primary election, a General election, and a Recall election. The elections selected were a Primary election from Sacramento County and a General election from Contra Costa County. The Sacramento County election definition was

provided by ES&S, just as it would be provided to a county that was contracting with ES&S for election definition services. The election definition for Contra Costa County was developed using delimited files of candidate, contest and precinct data, as they would be generated in an election office and used by the county to create its own election definition. The election definition for the recall election was coded from scratch during testing.

2. Phase I Functional Testing

Firmware Upgrades

The firmware from the trusted build was installed on the hardware components following the method described in ES&S's Use Procedures.

The firmware was successfully installed on the M100 and DS850.

The prod.release.img, rather than the update.img, file, was initially used to install firmware on the DS200. Errors were encountered because the prod.release.img file is designed for installations on newly manufactured machines rather than upgrades to previously installed firmware. When the correct file was used, firmware was successfully installed on five machines, but the sixth machine displayed errors. It appeared to be adversely affected by the previous attempt to load the incorrect file. ES&S personnel provided alternative procedures to update the machine's internal compact flash card with the prod.release.img file. The ES&S Use Procedures were amended to include this alternative procedure in case an initial firmware update turns out to be unsuccessful.

The installation on the M650 was complicated because the machine had been previously upgraded with the new firmware and the machine is designed to prevent identical firmware from being loaded onto it. For the purpose of testing, the firmware first had to be downgraded to an earlier version. Once the downgrade was accomplished, the firmware was successfully installed according to ES&S's Use Procedures.

A combination of errors in ES&S's Use Procedures and user errors complicated the firmware upgrade for the AutoMARK. ES&S was able to diagnose the problems and the firmware upgrade was ultimately successful. However, at the conclusion of Phase I testing, causes of the failure had not been determined. It was agreed that ES&S would provide documentation on the issue that would be reviewed and tested during Phase II testing. This is discussed in section 3, Phase II Functional Testing - AutoMARK Firmware Upgrade and Validation.

Firmware Validation

Following the firmware upgrades the plan was to follow ES&S validation procedures to create benchmarks for future validations. ES&S decided to withdraw their original validation procedures and present revised procedures during Phase II testing so this activity was deferred until that time. This is discussed in section 3, Phase II Functional Testing - AutoMARK Firmware Upgrade and Validation.

Primary Election

The Sacramento County, June 5, 2012 Presidential Primary election definition was used for this test. This election included one thousand forty-one precincts, seven partisan ballots, and a No Party Affiliation (NPA) ballot. ES&S prepared and provided the completed election definition as they would for a county with whom they contracted to provide election services. For the purpose of this test, the SOS requested that five precincts be selected that met the following criteria:

- One precinct that is entirely vote-by-mail (with no corresponding physical precinct)
- Two precincts that have identical ballot styles
- Two precincts that are located in the same Congressional district but different Assembly districts
- Two precincts with the same local contests (county or municipal) but different Supervisorial districts
- At least one of the numbered precincts must be among the 5% assigned the highest precinct numbers and one must be among the 10% assigned the lowest precinct numbers.

ES&S provided copies of the folders and data files for the Sacramento Primary election to populate the EDM and electdata folders in the test system. Instructions were provided in the Unity EMS Programming Guide revised in May, 2016. The appropriate folders were copied into the county and election databases and the results were checked for errors. The instructions in the Program Guide were followed to review samples of ballot proofs and verify that database tables were properly setup and linked. AIMS was populated by restoring the files from a backup file rather than a direct copy of the predefined files to the AIMS directory.

The Primary election was checked by capturing proofs of the ballot styles and other tools in EDM/ESSIM and copied to the EMS and ERM standalone workstations for later use. In order to select the options for ballot counting groups and reporting, ERM was not configured until ballot counting commenced in Phase II of the functional test.

With the assistance of ES&S, precincts P11400, P13102, P21728, P22740, and P89240 were selected.

A marking pattern and the corresponding expected results were created for the test decks. ES&S used the marking pattern to produce the test decks for Phase II testing. Elections programming media was produced for the tabulators and AutoMARKs.

General Election

The definition for the Contra Costa County, November 6, 2012 General election was used for this portion of the test. This election included eight hundred thirty-four precincts. The SOS requested that five precincts be selected using the same criteria as the Primary.

The Contra Costa County General election was installed on the EMS Client/Server. The installation used an election database from a prior election that provided district, precinct and office files. A new election was created by importing delimited text files of ballot instructions and candidates. When a candidate text file is imported from the preceding Primary election, the winners are not automatically promoted from the Primary into the General election definition. The list of candidates must be reviewed and candidates not in the General election must be deleted. Additional contests or questions that are not part of the imported files may be copied and pasted from other document or text files, then edited in ESSIM.

Once the ballot definitions were proofed, the General election was copied to the EMS and ERM standalone workstations for use in testing.

In order to select the options for ballot groups and reporting, ERM was not configured until ballot counting began.

With the assistance of ES&S, precincts 1, 5, 7, 234, and 828 were selected. Ballots were developed in ESSIM and Unity data was imported into AIMS and HPM. Election programming media was produced for use on the tabulators and AutoMARKs.

A marking pattern and the corresponding expected results were created for the test decks. ES&S used the marking pattern to produce the test decks for Phase II testing.

Recall Election

The test election is modeled after the October 7, 2003, California Gubernatorial Recall election. The election had one hundred thirty-five candidates with ballot positions and a write-in. The purpose of using this election is two-fold. First, it tests the system's ability to handle a contest with one hundred thirty-five candidates. It is also used to test the hardware's ability to read marginal marks and the consistency of the point at which marginal marks are not read. Although the limitation is not mentioned in system documentation, it was not possible to create an election with more than ninety-nine candidates. This was referred to ES&S for research and to be further addressed in Phase II. A ballot containing more than ninety-nine candidates is not necessary to test for marginal mark consistency so the ballots printed for this test were based on the election definition containing ninety-nine candidates.

Preparation for Red Team Testing

Prior to Phase I testing, a server and three workstations were prepared for the Red Team by cloning the machines built for the functional tests. During Phase I testing, copies of the Primary and General election definitions were copied from the functional test machines and installed onto the Red Team machines. Media for the hardware was created and installed. The machines were prepared up to the point of opening the polls, then sealed in accordance with ES&S's Use Procedures. Ballots from the Primary election were set aside for the Red Team's use.

3. Phase II Functional Testing

AutoMARK Firmware Upgrade and Validation

At the beginning of Phase II testing, ES&S withdrew the procedures originally prescribed for firmware upgrades on the AutoMARK, and presented revised procedures. The initial procedures only upgraded files that needed to be changed. Older files would not be overwritten if the content did not change between versions. This introduced the possibility that the firmware loaded on an upgraded machine could return hash values that would differ from those returned from a machine with a new installation of the same firmware. This could adversely affect the SOS's ability to validate the firmware on machines that had been upgraded. The new procedure included steps to wipe the software already residing on the device and install a clean version of the trusted build. The new procedure was followed and new versions of the firmware were successfully

installed. The procedure was added to Revision 5.0 of ES&S's Use Procedures, released June 22, 2016.

The AutoMARK hashes its own firmware. When the procedures provided by ES&S were followed, the AutoMARKs produced hash values that were documented in printed reports and screen photographs. These artifacts were provided to the SOS to use in their system validation program. The source code was reexamined and the hashing routines within that code were verified.

DS850 and DS200 Firmware Validation

In order to validate the firmware the jurisdiction must have access to a benchmark copy of that firmware, file listings and the hash value of each file. To validate a system, a script that generates file listings and the hash values of each file is run. The listings and hashes from that run are compared to the benchmark copy. An identical match of file names and hashes indicates that the system being examined is identical to the system used to create the benchmarks. If the benchmarks come from a certified device and the hash values of the system examined match then the system under examination is validated.

The benchmark hashes for the firmware may be taken from a machine subsequent to installing a trusted build of that firmware. It may also be acquired from a trusted source. The validation process follows validation procedures provided by ES&S and it runs ES&S proprietary scripts on a laptop or workstation using an Ubuntu operating system.

The scripts were examined to identify the program used to generate the hash values and to verify that the scripts are only text based and contain no binary elements. The program called to generate the hash values is a hashing utility that is part of the Coreutils package in Ubuntu. The script files are well documented internally and contain no binary elements.

At the beginning of Phase II testing, ES&S presented new procedures to hash the system. These procedures were followed with the assistance of ES&S. The trusted build of the firmware was installed on the machines in Phase I and benchmark hashes were created. Following the procedures for running the validation scripts confirmed that the hashes matched. During this process a number of errors were encountered in the procedure documentation. The document was revised during the week. At the end of the week after the test elections had concluded, the newly revised procedures were tested without the assistance of ES&S and it was confirmed that the hashes matched the benchmarks. During this process, more errors were found in the procedure documentation. ES&S was apprised of these errors and asked to correct the documentation. On July

8, 2016, following the conclusion of Phase II testing, ES&S submitted revised procedures to SOS. Staff used these revisions to validate the hardware and reported that they found no further errors in the documentation.

Temporary files are created when a system is hashed, so a successful match of the firmware will usually generate the message, “Two card images (from card partition files) DIFFER!” Since the wording of this message is less than assuring, an independent comparison of the hash benchmark and the hashing output was conducted using UltraCompare software. This comparison confirmed that all hash values were identical.

M650 Firmware Validation

The process used to validate the M650 is similar to, but a little more complex than, the DS850 and DS200. As with those machines, new procedures were presented and reviewed at the beginning of Phase II testing. A representative from ES&S used the new procedures to create the benchmark hash values and ran through the validation process. SOS staff used the revised procedures dated July 8, 2016, and successfully validated hardware with no reported documentation errors.

M100 Firmware Validation

The procedures provided by ES&S at the beginning of Phase II testing were followed to validate the firmware on an M100. The file names in the documentation did not match the files found on the equipment so ES&S provided additional assistance. The routine only creates screen displays; no report or other files are created. It is important that users capture screen shots of the output. SOS staff used the July 8, 2016, revised document to successfully validate the hardware and reported no errors in the documentation.

Workstation and Server Validation

At the beginning and end of Phase II testing, the workstations and server were hashed using FCMG batch files and a COTS hashing utility. The hash results were compared to benchmark hashes taken at the conclusion of system installation. The systems were successfully validated at the beginning and end of Phase II testing. Hash analysis shows that there were no unauthorized modifications to the computers used in the certification test from the time the system was installed to the conclusion of functional testing. The hash files produced at the conclusion of functional testing on June 18, 2016, also provide reliable benchmarks for the system that was tested.

Primary Election

The Primary election test was performed on the EMS client workstation networked to the EMS server. The EMS server contains no ES&S software and only serves as shared data storage for one or more networked EMS workstations. The first step was to load election definition media on one DS850, three DS200s, one M650, three M100s and four AutoMARKs. The original test plan included the ERM standalone workstation in the system configuration. However, during preparation for the Logic and Accuracy test, the machine would not run ERM. Upon closer examination, it turned out that hardening procedures used on the workstation were inconsistent with the version ES&S provided for the functional test. The hard drive was wiped and the system was rebuilt. As a result, the machine could not be used for approximately a day and a half. Rather than delaying the test until the machine could be rebuilt, the decision was made to exercise the ERM standalone in the General election. To ensure this error did not recur, the hardening on the other machines was audited and found in compliance before proceeding with the test.

Logic and Accuracy (L&A) testing was conducted in accordance with ES&S's Use Procedures. California requires that L&A tests be conducted in election mode so the test mode was not exercised. Zero reports were printed on all devices. Ballots were run. L&A results were printed and verified against expected results.

Ballots were voted on the AutoMARKs and hand marked ballots were added to the test decks and expected results.

After the L&A was completed, the ballots for the test election were run. The results from each of the scanners were printed and the data was loaded into ERM on the EMS client workstation. The results reports were printed. When the results were audited they were found to be identical to expected results.

During the Primary election, a number of documented bug fixes and enhancements were verified.

General Election

The General election was conducted on the EMS and ERM standalone workstations. The workstations are not connected to each other or a network. Results uploaded from scanners to the ERM workstation are transferred to the EMS workstation on a USB drive.

The election definition was loaded on one DS850, three DS200s, one M650, three M100s and four AutoMARKs. As with the Primary election, an L&A test was conducted in accordance with ES&S's Use Procedures. Zero reports were printed for all devices and ballots were run. L&A results were printed and verified against expected results.

Ballots were voted on the AutoMARKs and hand marked ballots were added to the test decks and expected results.

Following the L&A, the test election was run. Results were printed from all scanners. The scanner data was loaded into ERM on the EMS and ERM standalone workstations and results reports were printed. The results were audited and there was a slight variation from the expected results in two of the precincts. The ballots were hand counted and the hand count confirmed the machine count. The expected results were adjusted. During tabulation a small number of ballots were damaged and removed from the deck. Duplicates of the damaged ballots were created and added to the deck. The deviation from the expected results was caused by duplication errors.

As with the Primary election test, a number of documented bug fixes and enhancements were verified. These are discussed in the "Findings" section of this report.

Recall Election

After the Phase I test was concluded, ES&S researched the system's inability to create a ballot with more than ninety-nine candidates. The anomaly occurred because the election was defined using "relative positions". Relative positions are numbers in a two-digit field. The use of this two-digit field means there are only ninety-nine relative position numbers available and each candidate must be assigned a unique relative position number. Relative position numbers are used when candidate ballot positions need to be in an order other than the order in which the candidates are entered into the system. If candidates are entered in the order that they will appear on the ballot, or in the sequence that will appear in rotations, then there is no need to use the relative position numbers. ES&S demonstrated the ability to create a ballot with more than ninety-nine candidates.

The marginal mark consistency test was conducted using a ballot containing ninety-nine candidates and the election was defined as a vote for eighty contest. One ballot, containing a wide variety of marks, was created. A copy of this ballot appears in Attachment "A". The ballot was fed through each model of scanner ten times.

Central scanners are designed to reject unclear marks so election officials can review the ballot, make decisions about the voter's intent and duplicate the ballot. The M650 refused to tabulate a ballot with unclear marks but did not indicate which marks were not recognized. The DS850 would not tabulate a ballot with unclear marks, but it produced a report indicating how many unclear marks it detected on the ballot. The number of marks it found to be unclear on each of ten ballot passes was reasonably consistent and ranged from six to eleven out of eighty marks.

The precinct scanners produced tabulated totals that clearly showed which marks were always read, which were always not and which were marginal. Both the M100 and the DS200 were consistent. The marks that were inconsistently read were expected to be inconsistently read. The DS200 found slightly more marks to be readable and slightly more marginal marks consistently read.

AutoMARK Functionality

In each of the elections, ballots voted on AutoMARKs were added to the test decks. These ballots included marks voted in contests physically near the corners of the ballots, because the AutoMARK machine could mark outside of the target area if the ballot had not been inserted straight. The expected results for the elections were adjusted to include votes marked on these ballots. All marks produced on the ballots by the AutoMARK matched the voter's input and were read by the scanners. A ballot that was not part of the election was inserted in an AutoMARK. A pop up warning appeared and persisted until the ballot was ejected. It was verified that, in high contrast mode, any contest that is under voted flashes in the summary screen. Names entered in write-in contests are limited to twenty nine characters and are printed on the ballot in a single line without wrapping.

Ballot Scanner Functionality

The M100, DS200 and DS850 scanners performed as expected. Ballots were successfully fed in all four orientations; face up, upside down, backward and forward. A small number of misfed ballots and jams occurred. These generally happened when the operators feeding the ballots inserted a ballot before the previous ballot had finished being scanned.

Although the ballots were successfully tabulated on the M650 scanner, difficulties were experienced during its operation. It is a complicated machine to operate. It requires a trained and experienced operator. In order to feed the ballots, the operator must apply slight thumb pressure to

the ballots in the in-feed tray. It is very sensitive to the amount of pressure. When a misfeed or jam occurs, the machine produces ambiguous error messages. The only way to determine whether to rescan a ballot is to count the number of cards in the output hopper and compare the count to the number of cards counted on the display to determine if all cards in the hopper have been counted.

If a ballot is accidentally scanned twice, the only remedies are to either "flush" the precinct or clear the machine of all tabulated ballots. According to documentation provided by ES&S, flushing a precinct requires a "flushing header card". ES&S did not provide such a card and the documentation did not indicate how to make one. When this occurred during testing, both the precinct being counted and a prior precinct had to be cleared, then both precincts recounted. After the recount, the results were written to a zip disk at the completion of each precinct so results from ballots in previously scanned precincts would not be lost if the machine needed to be cleared.

The M650 only handles ballots in one orientation. The ballots must be loaded in the input hopper face up, with the top of the ballot to the left and the notched corner in the corner of the input hopper. The ballots had a tendency to curl. This caused ballots to hit the top edge of the scanner mouth, resulting in numerous jams and rapid ballot fatigue. This may have been a result of the ballots being misprinted (upside down) and fatigue partially attributed to running the same ballots multiple times through successive scanners (and L&A).

Final Results Reporting Capability

The system can accommodate provisional and late processed absentee ballots by either adding to previously tabulated totals or setting up separate reporting groups for the additional ballots.

Certified write-in candidates are not handled by the voting system and were not included in the election definition. After canvasing, write-ins must be hand counted and manually entered into the statement of votes cast.

4. Red Team Testing

Findings (Physical Security)

Several physical security vulnerabilities were discovered on all of the scanners as well as the AutoMARK ballot marker. These vulnerabilities include:

- Easily picked security locks
- Easy to moderate compromise of integrity seals
- Removal of integrity stickers from plastic cases without triggering integrity safeguard
- Access to ballot box with wire seals in place

The seals and all but one of the locks (the double sided locks on the DS850) are vulnerable to straightforward attacks and the tamper evidence labels can be removed without triggering the tamper safeguards if applied to plastic surfaces.

An additional vulnerability on the DS850 is that a thin, stiff probe can be inserted through the door hinge gap allowing the power switch to be activated or deactivated by unauthorized personnel.

Findings (Vulnerability Assessment)
Federal Information Assurance Compliance

Using the NIST Security Content Automation Protocol (SCAP), all Unity servers and workstations were scanned for misconfigurations according to US federal IA standards. These standards conform to mitigating known vulnerabilities and hardening target systems on a US government network.

The following represents a summary of misconfigurations on each of the Unity systems. As a note, the Unity client, standalone, and ERM system have the same general configuration and have been merged as one finding:

Unity Server

- Windows 2008 R2 OS: **131**
- Firewall Configuration: **12**
- .NET Framework 4 Configuration: **5**
- Internet Explorer 9 Configuration: **121**

Unity Client / Standalone / ERM Workstation

- Windows 7 OS: **155**
- Firewall Configuration: **20**
- .NET Framework 4 Configuration: **4**
- Internet Explorer 9 Configuration: **124**

Kernel Vulnerabilities in the DS200 and DS850

Upon analysis of the custom Linux operating system for the DS200 and DS850, it was discovered that the kernel has multiple vulnerabilities based on the versions recovered from the systems. The vulnerabilities discovered were reported by www.cvedetails.com for the specified Linux kernel. It should be noted that none of the vulnerabilities were actively tested during the on-site test.

Memory Imaging of DS200 and DS850

The version of the Linux operating system on the DS200 and DS850 systems allows trivial memory imaging. If an attacker was able to access the system, they can use binaries from the operating system to obtain a complete memory [RAM] image.

While this not considered a serious vulnerability, it does allow an attacker to attempt to recover encryption keys, passwords, and other vital system runtime information.

DS200 Unencrypted File System

Upon investigation of the DS200 and DS850 compact flash cards, it was determined that the file systems were not encrypted. While the DS850 did not allow the system to boot into a modified version of the compact flash card, the DS200 did.

Access to an unencrypted file system allowed the analyst to recover system configuration information, user password hashes, and the ability to modify the boot device. Since the analyst was able to modify the DS200's boot loader and gain console access to the system, via single user mode, the next focus was gaining access via the SSH server.

Once the user password hashes were recovered from the system, they were run through a specialized password cracking system using graphics cards. The root password hash was cracked within forty six seconds using a common dictionary attack. The password was confirmed by successfully logging into the SSH server from a remote system. From here, the analyst used this to successfully gain access to an unmodified DS200 within the lab environment.

DS200 Network Configuration

Even though the DS200's Ethernet port is located within the enclosure and not accessible, it is still active by default and configured with a static IP

address. Furthermore, it was discovered that an SSH server was installed and allows “root” user logins.

Access to Raw Ballot Data (DS200)

Once an election is complete, the DS200 will transfer the results to an external USB flash device for tallying on the Unity Election Management System. It was discovered that these results are the actual scanned ballot images in bitmap format and are not encrypted nor appear to have file integrity mechanisms. Using common image editing software, an analyst was able to modify the bitmap image and save it in its accepted format.

5. AutoMARK Accessibility Functions

An AutoMARK with the test Primary election already installed was set up with speakers rather than headphones so the operator and observers could listen to the audio output.

In order to determine whether ballots are presented to the voter in a consistent manner, two ballots were voted using the audio mode with the video turned on. The information displayed on the screen was compared to the information provided in the audio stream and found to be the same. A third ballot was voted using only the audio mode with video option turned off.

One ballot was voted using the Yes/No paddle switch interface. The audio instructions are specific to the control panel found on the AutoMARK and not for use with the paddle switch. The button used for “Select” and “Yes” selects contests, candidates and the items in the scroll/navigation bar at the bottom of the screen. The button used for “Scroll” and “No” scrolls through the contests, candidates and the navigation bar at the bottom of the screen. When a contest is fully voted, the script instructs the voter to press the right arrow key to go to the next contest. However, when the paddle switch is used to go to the next contest, the voter needs to press the No button on the left side of the paddle. Navigation through the ballot is not intuitive, but it is possible to navigate and vote the ballot. Absent instruction, the voter may be left to figure out the process through trial and error.

One ballot was voted using the sip and puff interface switch. The operation is essentially the same as for the paddle switch, with a puff being equivalent to the “Select” and “Yes” button and a sip being equivalent to the “Scroll” and “No” button.

The audio ballot and video ballot modes are able to work both separately and simultaneously. During simultaneous operation, the audio ballot

notifies the voter that the video ballot is enabled. Although unlikely, it is possible for a voter to turn the video ballot off and lower the volume of the audio ballot to the point that they would be unable to continue voting or recover from their error.

The instructions given by the machine are adequate for a voter to be able to independently operate the AutoMARK if the voter is using the touchscreen or buttons on the control panel. The instructions do not include how to operate the paddle switch and sip and puff devices. Although these devices are used infrequently, supplemental instructions should be provided to voters who use them.

The AutoMARK presents the voter with the races that he or she is eligible to vote, the candidates available in each race and told how many candidates may be selected in each race.

The voter can determine whether their inputs have selected the candidates or responses to questions they intended to select and can review the selections they have made. Prior to casting the ballot, the voter can change any selection previously made and confirm the new selection.

The system notifies the voter when they have failed to vote in a race or have failed to vote the number of total number candidates allowed in any race and requires the voter to confirm their intent to under vote before casting the ballot. The system prevents the voter from over voting any race.

A voter using the AutoMARK can write in a candidate name in contests that allow write-in candidates. However, if a voter uses the paddle or sip and puff interfaces, this may prove to be difficult. These devices allow the voter to proceed through the alphabet, space, backspace, cancel and OK buttons, but these actions are in a continuous string and operate in only one direction. For example, entering “ZEBRA” using one of these devices requires three trips through the alphabet, one to get to Z, then back to the beginning to get to E, in order to get back to B the voter must run through the remainder of the alphabet and buttons. From the B they can proceed down to R, but must go through the remainder of the string to get back to A. This results in a total of one hundred fifteen button presses or sip and puff actions.

The voter is able to review their write-in input, edit the input, and confirm that the edits meet their intent.

There is a clear, identifiable action that the voter takes to “cast” the ballot. The system clearly instructs the voter through this process. Once the

ballot is cast, the system confirms that the action occurred and that the process of voting is complete.

The system provides wheelchair accessibility and the voting booth meets or exceeds the required 30” wide and 19” deep. Inside the voting booth, voter operable controls will rest with a minimum height of 36” above the finished floor with a minimum knee clearance of 27” above the floor. The AutoMARK may also be used on top of a table.

The system was successfully operated using only one hand, as well as a closed fist. The force required to operate these controls was light and required no pinching or twisting of the wrist. The closed fist approach worked best with the first finger joint knuckles. It was difficult with the finger base knuckles. It was easy with the paddle switches.

The AutoMARK allows a voter who has already marked their ballot, either by hand or by using the AutoMARK, to review their ballot and the results of the review can be displayed on the screen or read by the system audio. To exercise this function, a ballot was marked with a variety of conditions including an over vote, an over vote with a write-in, a properly voted race with a candidate selection, a properly voted write-in with the candidate name, a marked write-in with no name and a write in name with no mark, and under voted contests. The results were as expected. The system correctly identified the voted contests without regard to the write-in text. However, if the voter leaves an under voted contest on the ballot, the system will not allow them to vote the under voted race. It instructs them to contact an election official for a new ballot. This leaves the voter with the option to either spoil a ballot or use a pen to correct the under vote.

When the AutoMARK finishes marking a ballot, it ejects it. The voter removes the ballot from the AutoMARK and inserts it in a precinct counter. Upon ejection, the ballot is held in the throat of the machine with a fair amount of tension. A considerable amount of hand strength is required to remove the ballot and it is most easily removed by using both hands and gripping it on each side. Voters with limited hand strength or the use of only one hand may require assistance to remove their ballot rather than independently removing their ballot and completing the process of voting.

6. Volume Testing

Fifteen temporary contract workers (test voters) were hired by the Secretary of State to simulate Election Day tabulation on the M100, and DS200 tabulators. Twenty temporary contract workers (test voters) were hired by the Secretary of State to simulate Election Day voting on the AutoMARK. The overall testing environment was recorded continuously

on videotape and videos were taken of error messages displayed on the AutoMARK, M100, and DS200 for documentation. Each error was documented as to whether it was attributed to the equipment or to human performance.

A total of one hundred ten machines were tested. Twenty M100s, fifty DS200s, ten each of the AutoMARK, version1.0 and version 1.1 respectively, and twenty AutoMARKs, version 1.3 were tested. Fourteen test decks provided by ES&S were used to test the tabulators, and each test deck was tabulated approximately five times in different machines. Several ballots in each test deck were hand marked to simulate over-vote conditions as well. The testing included tabulating approximately four hundred ballots consisting of two pages each (eight hundred sheets) on each M100, four hundred ballots on each DS200, and casting one hundred ballots on each AutoMARK machine. A total of eight thousand ballots were tabulated on M100 tabulators, twenty thousand ballots were tabulated on DS200 tabulators, and four thousand ballots were cast on the AutoMARK machines.

ES&S was allowed to perform minimal maintenance during the testing, including calibrating the scanners and printers, calibrating the touch screen displays, inspecting and cleaning the units, and rebooting the system. ES&S limited preventative maintenance to those machines that displayed a significant number of errors.

Fourteen test decks of four hundred ballots (eight hundred sheets) each provided by ES&S were used to feed through the seventy tabulators. Many ballots started to show bends and tears after going through several tabulators. Approximately twenty four were replaced with fresh ballots. The M100 tabulators were tested first, and experienced six errors. Of the six errors, four were “Ballot Jam” errors and two were “Diverter Control” errors. The DS200 tabulators were tested second, and experienced forty one errors. Of the forty one errors, twenty two were “Ballot Counted But Not Saved” errors, two were “Ballot Too Long” errors, and sixteen were ballots that jammed in the machine. In every case, the DS200 tabulator was slid forward on the bin, the ballot pushed into the bin, and the tabulator was slid back into place on the bin. ES&S personnel explained that the common “fix” for this problem is to shake the bin to settle ballots inside, and then resume tabulation. In actual practice, the “shake” fix seemed to resolve the problem for the next two to fifteen ballots, and then the problem surfaced again.

After the test decks were tabulated, the paper audit trail record was utilized to check for errors. The paper tapes were compared to make sure the results from each tabulator that a specific test deck was used on were consistent. Two errors were encountered related to this: at two points test

decks got co-mingled. Secretary of State staff resolved this by establishing them as new test decks, and comparing the results forward. One test deck ended up with additional ballots, which was verified by counting the actual ballots. It was determined that a temporary contract worker mistakenly added ballots to his deck.

After test voters completed marking their ballot decks on the AutoMARKs, they reviewed each of their ballots and identified those ballots that contained poor markings. The Secretary of State's staff reviewed these ballots, looking for ballots with marks which were sufficiently poor, or outside the target area, that might cause errors in tabulation. They selected ninety six ballots, which appeared most likely to generate tabulation errors. Each of these ninety six ballots was read into an M100 tabulator, and then a DS200 tabulator. The results of each tabulation were compared to make sure the counts were the same. Despite poor quality or placement of marks on these ballots, the M100 scanner tabulated these ballots with zero errors, and the DS200 scanner tabulated them with one error.

A number of anomalous events occurred during testing of the AutoMARKs. The events were recorded on incident reports as they occurred. The incident reports show the following:

Ballot Not Recognized – This occurred when the voter inserts the unmarked ballot into the machine and the machine fails to recognize the ballot. The ballot is ejected back to the voter. There were no invalid ballots in the decks. The ballot was recognized when the ballot was inserted a second time. This error occurred two times during the test.

There was one instance where the message "Ballot Not Recognized" appeared, the unit froze and had to be rebooted in order to continue the test.

There was one occurrence of the "Ballot Not Recognized" error in conjunction with a ballot jam. It was not determined whether the machine jammed while trying to handle the recognition error or whether the jam caused the ballot to not be recognized.

The "Ballot Not Recognized" message seems to occur less frequently when the ballot is inserted into the unit slowly. The California Secretary of State has determined that these errors will be considered human behavior errors rather than machine errors.

Although the situation is easily remedied, poll workers need to be trained to expect this situation and know how to handle it properly.

Ballot Jam – There was one ballot jam that required ES&S staff to clear the jam. To clear the jam, the AutoMARK was switched over to test mode and the option to "eject the ballot" was selected. ES&S's preferred method to clearing this error is to switch the machine to test mode and select the option to "eject ballot". If this does not clear the jam, then open up the machine and remove the ballot manually. Poll workers must be trained to deal with these types of occurrences.

Printing Error - There were a total of seven "Printing Error" errors. These errors occurred after the voter had completed voting his or her ballot and selected "print ballot." While the ballot was being marked, the AutoMARK would stop while the ballot was inside the unit and the screen would display the message: "Printing Error." This error requires intervention from the poll worker in order to resolve this issue. The poll worker is required to set the AutoMARK to test mode and select the option "Eject the Ballot." Once the ballot is ejected, the poll worker must then place the AutoMARK back in voting mode. When the ballots were ejected, two had been marked and two had not been marked.

Loss of Screen Calibration - There was one instance where the touchscreen of an AutoMARK drifted out of calibration during the test. Poll workers should be trained to check screen calibration and be alert to voters encountering calibration issues.

Machine froze and required rebooting - There were four instances where a machine froze while attempting to read and mark a ballot. In each instance, it required ES&S staff to reboot the machine. Once the machine was rebooted, ES&S staff had to go through the process of removing the ballot from inside the machine by either placing the machine in test mode then selecting the "Eject Ballot" option or by opening the machine and manually removing it.

Findings

During the course of this test, no ballot was lost and no conditions were experienced which would cause a ballot to be irretrievably lost. In the one instance when the print quality of a ballot marked by one of the AutoMARK units was so poor as to be unreadable by the DS200 tabulating scanner, it was read correctly by the M100 scanner. The ballot that was unreadable in the DS200 scanner was a "snowman", whereby the mark was on top of the actual bubble, the damage was not obvious, and there was not some other condition that prompted the test voter to seek assistance and obtain a replacement ballot.

The number and nature of anomalies encountered during the test show that the DS200 diverter bins require a medium to high level of maintenance and poll worker training when used to tabulate large numbers of ballots. While properly trained poll workers can easily handle most of the anomalies discussed above, any one of these anomalies, if unaddressed, could bring use of the DS200 precinct tabulator in a polling place to a halt. If poll workers are trained to deal with these anomalies without reliance on rovers or responses to service calls, then the disruption from these types of events can be minimized.

IV. COMPLIANCE WITH STATE AND FEDERAL LAWS AND REGULATIONS

Six sections of the California Elections Code, Sections 19101, 19203, 19204, 19204.5, 19205, and 19270, describe in detail the requirements any voting system must meet in order to be approved for use in California elections. These sections are described in detail and analyzed for compliance below.

1) §19101 (b) (1): The machine or device and its software shall be suitable for the purpose for which it is intended.

   The system meets this requirement.

2) §19101 (b) (2): The system shall preserve the secrecy of the ballot.
   The system presented for testing lacked both a privacy screen and a privacy sleeve for voters using the AutoMARK. With the addition of both, the system should protect the secrecy of the ballot.

3) §19101 (b) (3): The system shall be safe from fraud or manipulation.

   The system is at least as secure as the previously certified version of this ES&S system. The addition of the DS200 precinct scanner and the DS850 central scanner to the system does not introduce new risks to fraud or manipulation.

4) §19101 (b) (4): The system shall be accessible to voters with disabilities pursuant to section 19242 and applicable federal laws.

   The system meets this requirement.

5) §19101 (b) (5): The system shall be accessible to voters who require assistance in a language other than English if the language is one in which a ballot or ballot materials are required to be made available to voters pursuant to Section 14201 and applicable federal laws.

   The system meets this requirement.

6) §19203: The system shall use ballot paper that is of sufficient quality that it maintains its integrity and readability throughout the retention period specified in sections 1700 through 17306.

   The system meets this requirement.

7) §19204: The system shall not include procedures that allow a voter to produce, and leave the polling place with, a copy or facsimile of the ballot cast by that voter at that polling place.

   The system meets this requirement.

8) §19204.5 (a): The system shall facilitate the conduct of a ballot level comparison risk-limiting audit.

   The system meets this requirement.

9) §19205 (a): No part of the voting system shall be connected to the internet at any time.

   The system meets this requirement.

10) §19205 (b): No part of the voting system shall electronically receive or transmit election data through an exterior communication network, including the public telephone system, if the communication originates from or terminates at a polling place, satellite location, or counting center.

    The system meets this requirement.

11) §19205 (c): No part of the voting system shall receive or transmit wireless communications or wireless data transfers.

    The system meets this requirement.

12) §19270 (a): The Secretary of State shall not certify or conditionally approve a direct recording electronic voting system unless the system includes an accessible voter verified paper audit trail.

The system meets this requirement.

1. **Review of Other Relevant Elections Code Sections.**

   1) §15360. During the official canvass of every election in which a voting system is used, the official conducting the election shall conduct a public manual tally of the ballots tabulated by those devices cast in one percent of the precincts chosen at random by the elections official. If one percent of the precincts should be less than one whole precinct, the tally shall be conducted in one precinct chosen at random by the elections official.

      In addition to the one percent count, the elections official shall, for each race not included in the initial group of precincts, count one additional precinct. The manual tally shall apply only to the race not previously counted.

      The system fully supports this requirement.

   2) §19300. A voting machine shall, except at a direct primary election or any election at which a candidate for voter-nominated office is to appear on the ballot, permit the voter to vote for all the candidates of one party or in part for the candidates of one party and in part for the candidates of one or more other parties.

      The system meets this requirement.

   3) §19301. A voting machine shall provide in the general election for grouping under the name of the office to be voted on, all the candidates for the office with the designation of the parties, if any, by which they were respectively nominated.

      The designation may be by usual or reasonable abbreviation of party names.

      The system meets this requirement.

   4) §19302. The labels on voting machines and the way in which candidates' names are grouped shall conform as nearly as possible to the form of ballot provided for in elections where voting machines are not used.

      The system meets this requirement.

   5) §19303. If the voting machine is so constructed that a voter can cast a vote in part for presidential electors of one party and in

part for those of one or more other parties or those not nominated by any party, it may also be provided with: (a) one device for each party for voting for all the presidential electors of that party by one operation, (b) a ballot label therefore containing only the words “presidential electors” preceded by the name of the party and followed by the names of its candidates for the offices of President and Vice President, and (c) a registering device therefore which shall register the vote cast for the electors when thus voted collectively.

If a voting machine is so constructed that a voter can cast a vote in part for delegates to a national party convention of one party and in part for those of one or more other parties or those not nominated by any party, it may be provided with one device for each party for voting by one operation for each group of candidates to national conventions that may be voted for as a group according to the law governing presidential primaries.

No straight party voting device shall be used except for delegates to a national convention or for presidential electors.

The system complies with these requirements.

6) §19304. A write-in ballot shall be cast in its appropriate place on the machine, or it shall be void and not counted.

The system complies with this requirement.

7) §19320. Before preparing a voting machine for any general election, the elections official shall mail written notice to the chairperson of the county central committee of at least two of the principal political parties, stating the time and place where machines will be prepared. At the specified time, one representative of each of the political parties shall be afforded an opportunity to see that the machines are in proper condition for use in the election.

The party representatives shall be sworn to perform faithfully their duties but shall not interfere with the officials or assume any of their duties. When a machine has been so examined by the representatives, it shall be sealed with a numbered metal seal. The representatives shall certify to the number of the machines, whether all of the counters are set at zero (000), and the number registered on the protective counter and on the seal.

The system meets this requirement.

8) §19321. The elections official shall affix ballot labels to the machines to correspond with the sample ballot for the election. He or she shall employ competent persons to assist him or her in affixing the labels and in putting the machines in order. Each machine shall be tested to ascertain whether it is operating properly.

    The system supports this requirement.

9) §19322. When a voting machine has been properly prepared for an election, it shall be locked against voting and sealed. After that initial preparation, a member of the precinct board or some duly authorized person, other than the one preparing the machines, shall inspect each machine and submit a written report. The report shall note the following: (1) Whether all of the registering counters are set at zero (000), (2) whether the machine is arranged in all respects in good order for the election, (3) whether the machine is locked, (4) the number on the protective counter, (5) the number on the seal. The keys shall be delivered to the election board together with a copy of the written report, made on the proper blanks, stating that the machine is in every way properly prepared for the election.

    The system supports this requirement.

10) §19340. Any member of a precinct board who has not previously attended a training class in the use of the voting machines and the duties of a board member shall be required to do so, unless appointed to fill an emergency vacancy.

    The system does not adversely impact this requirement.

11) §19341. The precinct board shall consist of one inspector and two judges who shall be appointed and compensated pursuant to the general election laws. One additional inspector or judge shall be appointed for each additional voting machine used in the polling place.

    The system does not adversely impact this requirement.

12) §19360. Before unsealing the envelope containing the keys and opening the doors concealing the counters the precinct board shall determine that the number on the seal on the machine and the number registered on the protective counter correspond to the numbers on the envelope.

Each member of the precinct board shall then carefully examine the counters to see that each registers zero (000). If the machine is provided with embossing, printing, or photography devices that record the readings of the counters the board shall, instead of opening the counter compartment, cause a "before election proof sheet" to be produced and determined by it that all counters register zero (000).

If any discrepancy is found in the numbers registered on the counters or the "before election proof sheet" the precinct board shall make, sign, and post a written statement attesting to this fact. In filling out the statement of return of votes cast, the precinct board shall subtract any number shown on the counter from the number shown on the counter at the close of the polls.

The system supports this requirement.

13) §19361. The keys to the voting machines shall be delivered to the precinct board no later than twelve hours before the opening of the polls. They shall be in an envelope upon which is written the designation and location of the election precinct, the number of the voting machine, the number on the seal, and the number registered on the protective counter. The precinct board member receiving the key shall sign a receipt.

    The envelope shall not be opened until at least two members of the precinct board are present to determine that the envelope has not been opened.

    At the close of the polls the keys shall be placed in the envelope supplied by the official and the number of the machine, the number written on the envelope.

    The system supports this requirement.

14) §19362. The exterior of the voting machine and every part of the polling place shall be in plain view of the election precinct board and the poll watchers.

    Each machine shall be at least four feet from the poll clerk's table.

    The system supports this requirement.

2. **Review of Federal Statutes or Regulations.**

The Voting Rights Act of 1965, as amended (42 U.S.C. 1973), requires all elections in certain covered jurisdictions to provide registration and voting materials and oral assistance in the language of a qualified language minority group in addition to English. Currently in California, there are ten VRA languages (English, Spanish, Chinese, Hindi, Japanese, Khmer, Korean, Tagalog, Thai, and Vietnamese) as prescribed under the law.

The system fully meets this requirement. The system's paper ballots can be easily printed in these languages, as well as any others. Further, the AutoMARK can be programmed to display the ballot in any of these languages on the touch screen interface and to provide audio instruction in any of these languages.

The National Voter Registration Act of 1993 (42 U.S.C. 1973gg and 11 CFR 8) allows for the casting of provisional ballots through Fail-Safe Voting procedures.

Provisional ballots can easily be cast with this system. Because the AutoMARK only marks ballots (or verifies the marking of a ballot), it has no impact on provisional voting.

The Voting Accessibility for the Elderly and Handicapped Act of 1984 (42 U.S.C. 1973ee through 1973ee-6) requires each political subdivision conducting elections within each state to assure that all polling places for federal elections are accessible to elderly and handicapped voters, except in the case of an emergency as determined by the state's chief election officer or unless the state's chief election officer: (1) determines, by surveying all potential polling places, that no such place in the area is accessible or can be made temporarily accessible, and (2) assures that any handicapped voter assigned to an inaccessible polling place will, upon advance request under established state procedures, either be assigned to an accessible polling place or be provided an alternative means of casting a ballot on election day.

This system supports this requirement.

The Retention of Voting Documentation (42 U.S.C. 1974 through 1974e) statute applies in all jurisdictions and to all elections in which a federal candidate is on a ballot. It requires elections officials to preserve for twenty two months all records and papers which came into their possession relating to an application, registration, payment of a poll tax, or other act requisite to voting. Note: The US Department of

Justice considers this law to cover all voter registration records, all poll lists and similar documents reflecting the identity of voters casting ballots at the polls, all applications for absentee ballots, all envelopes in which absentee ballots are returned for tabulation, all documents containing oaths of voters, all documents relating to challenges to voters or absentee ballots, all tally sheets and canvass reports, all records reflecting the appointment of persons entitled to act as poll officials or poll watchers, and all computer programs used to tabulate votes electronically. In addition, it is the Department of Justice's view that the phrase "other act requisite to voting" requires the retention of the ballots themselves, at least in those jurisdictions where a voter's electoral preference is manifested by marking a piece of paper or by punching holes in a computer card.

The system meets this requirement. All votes in this system are recorded on paper ballots that can be easily retained

The Help America Vote Act (HAVA) §301(a) mandates several requirements for voting systems, including:

1) The ability to verify the vote choices on the ballot before that ballot is cast and counted,
2) Notification to the voter of over-votes on a ballot,
3) Auditability with a permanent paper record of votes cast,
4) Accessibility for individuals with disabilities, including nonvisual accessibility for the blind and visually impaired, in a manner that provides the same opportunity for access and participation (including privacy and independence)

This system supports these requirements in the following manner:

1) The paper ballots themselves lend themselves to visual inspection and verification.
2) The AutoMARK provides its users with a ballot review screen prior to printing the ballot. Further, any voted ballot can be inserted into the ballot for review and verification.
3) The AutoMARK prevents over-voting a contest. The Model M100 scanner can be programmed to provide a warning when over-voted ballots are inserted into the scanner.
4) Because all ballots in this system are paper based, there is a fully auditable permanent record of the election.
5) Deployment of the AutoMARK in a precinct provides accessibility for persons with disabilities at the polling place.

V. CONCLUSION

The ES&S Unity 3.4.1.0 voting system, in the configuration tested and documented by the California Installation and ES&S's Use Procedures, meets all applicable California and federal laws. The ES&S Unity 3.4.1.0 voting system is compliant with all California and federal laws.

Attachment A
Marginal Marks Ballot